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A Scoping Review: Metabolomics Signatures Associated With Animal or Plant Protein Intake and Their Potential Relation to Cardiometabolic Risk

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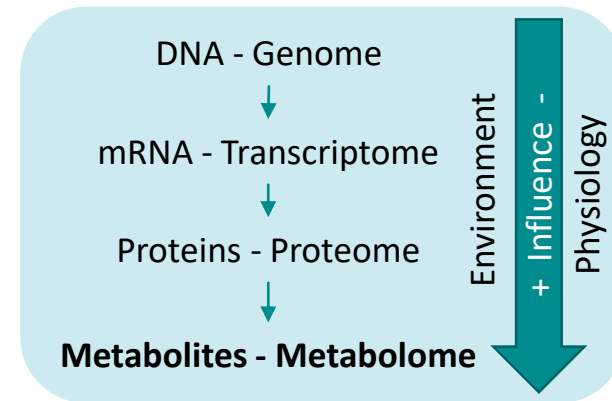
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Context:

- A dietary shift from **animal protein (AP)** to **plant protein (PP)** sources have been associated with lower cardiovascular and diabetes risk
- Mechanisms are still poorly characterized and might involve many metabolic pathways.



Metabolomics is a relevant tool to explore subtle metabolic reorientations as it provides **an integrative characterization of the phenotype expressed**

Objective:

This scoping review is aimed at **gathering and analyzing the available metabolomics data associated with PP and AP-rich diets, and discussing the metabolic effects underlying these metabolomics signatures and their potential implication for cardiometabolic health**

Results:

- 24 studies selected**

Study design	Dietary comparison	n [ref]
Observational studies	AP and PP intake	1 [1]
	Omnivores vs vegetarians or vegans	6 [2-7]
	Adherence levels to defined dietary patterns	6 [8-13]
	Adherence to a posteriori (data-driven) dietary patterns	3 [14-16]
Interventional studies	Omnivores vs vegetarians or vegans	3 [17-19]
	Adherence levels to defined dietary patterns	5 [20-24]

Table 1: Classification of the studies selected

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- 439 metabolites reported across studies** (mean $S_M = 0.89$)

- High heterogeneity** among the reported metabolites
- Metabolites related to amino acid and protein metabolism** have the highest contribution

- 46 metabolites associated to AP or PP-rich diet with a high level of evidence** ($S_M > 1,51$)

- proteinogenic amino acids (30% of the 46 metabolites)
- Biomarkers of animal products intake
- TCA cycle intermediates
- Very few lipids

Method:

1. Criteria for study selection

- Metabolomics signatures
 - Metabolomics analyses only
 - Urine, plasma and serum
 - Human only
 - Observational and interventional studies

AP and PP intake

- Direct comparison of AP and PP intake
- Comparison of diets with contrasted AP and PP intake:
 - omnivores with vegetarians or vegans
 - adherence levels to defined dietary patterns (Mediterranean diet, HEI, DASH)
 - a posteriori (data-driven) dietary patterns

2. Scoring system for study contribution

Dietary contribution score S_p to account for the expected AP and PP intake differences across studies:

Type of dietary comparison	S_p
Comparison of a posteriori (data-driven) dietary patterns	0.25 (+0.125)
Comparison based on adherence to defined dietary patterns	0.5 (+0.125)
Comparison of omnivore, vegetarian and vegan diets	0.75 (+0.125)
Comparison based on AP and PP intake	1

+0.125 for studies providing detailed dietary data confirming intake differences in AP and PP-rich foods across groups

Study design contribution score S_D to account for the difference in evidence level providing by the study design:

Study design	S_D
Mechanistically based reasoning	0.2
Case-control studies	0.4
Non-randomized controlled cohort	0.6
Randomized trials	0.8
Systematic review of randomized trials	1

Assigning an **overall contribution score S_c to each study included** : $S_c = (S_p + S_D) / 2$

3. Metabolite selection

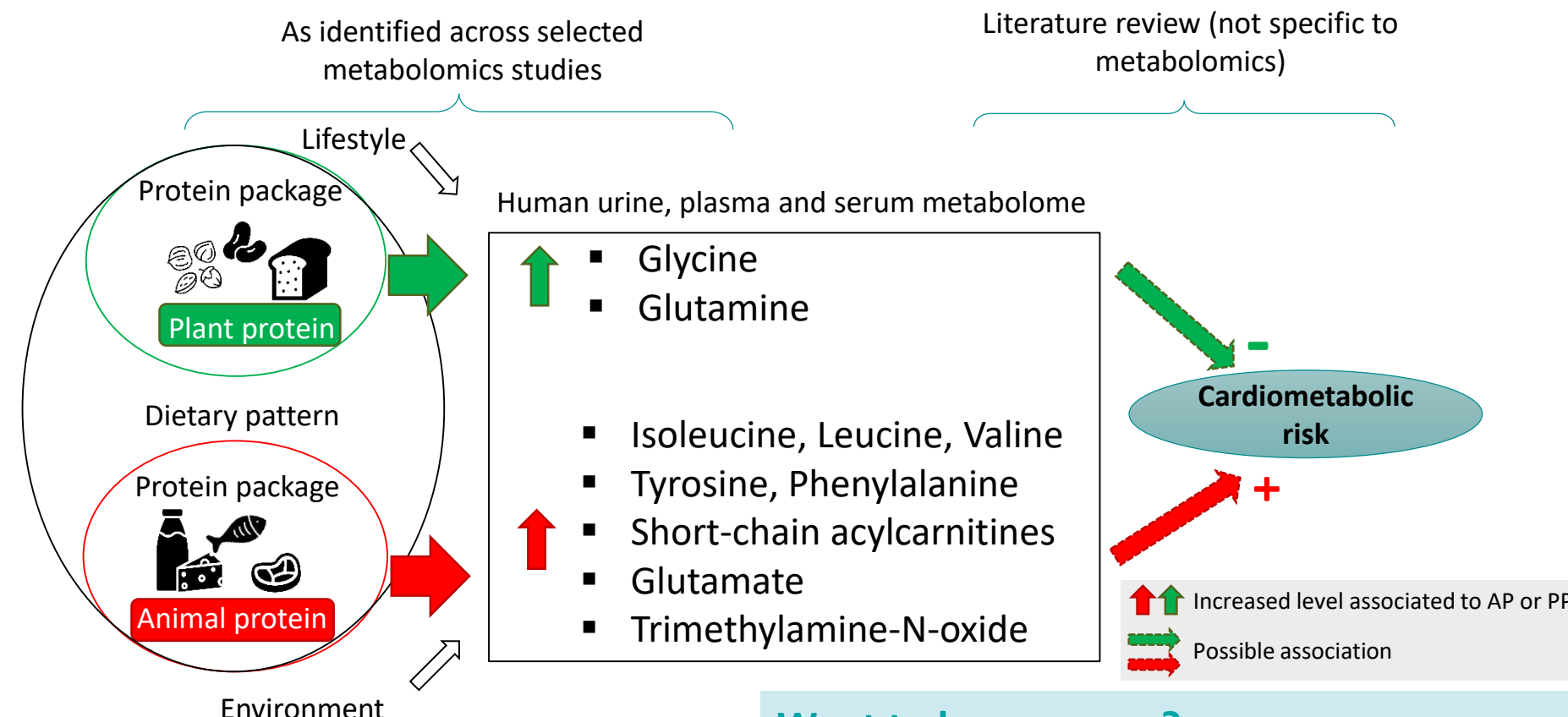
- Compilation of all metabolites reported as discriminant between groups in each study and cross-analysis between studies
- Attribution of a **metabolite score S_M to each metabolite reported**:

$$S_M(\text{metabolite A}) = \sum S_c (\text{studies reporting metabolite A})$$
- Selection of the metabolites with the highest S_M

4. Metabolite review

Literature review on the links between the selected metabolites and cardiometabolic risk

Discussion: Main metabolites discriminant between AP and PP-rich diets and their potential implication in cardiometabolic risk



Conclusions:

- AP and PP-rich diets are associated with distinct metabolites which are plausible candidates to explain some of the differential associations between diet type and cardiometabolic risk
- Very little data is available regarding the metabolomics signatures specifically associated to AP and PP intake
- More studies with a specific focus on protein type, detailed dietary data and tight intake control (see poster **P28-011-21**) are needed to better characterize the metabolomics signatures associated to AP and PP intake

Want to know more ?

Article in press for publication in *Advances in Nutrition* : Lépine et al, A scoping review: metabolomics signatures associated with animal and plant protein intake and their potential relation to cardiometabolic risk